Preliminary Studies on Coastal Habitat Occupancy by Lobsters, *Homarus americanus*, in Relation to Dredge Spoil Disposal in the Approaches to Saint John Harbour, New Brunswick, Canada

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Preliminary studies on coastal habitat occupancy by lobsters, *Homarus americanus*, in relation to dredge spoil disposal in the approaches to Saint John Harbour, New Brunswick, Canada

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ABSTRACT

Lawton, P., MacIntyre, A.D., Robichaud, D.A., and Strong, M.B. 2005. Preliminary studies on coastal habitat occupancy by lobsters, *Homarus americanus*, in relation to dredge spoil disposal in the approaches to Saint John Harbour, New Brunswick, Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2718: iv + 23 p.

Lobster traps (with closed escape vents) were fished at three locations in the approaches to Saint John Harbour in July 2004, after the commercial fishery closed but prior to annual dredge disposal activity at the Black Point Ocean Disposal Site. A total of 2840 lobsters were retained in 134 trap hauls conducted over four sampling dates. Sub-legal lobsters (<83 mm carapace length) were most abundant, averaging 11-22 per trap haul on a daily basis. Legal-sized lobsters (2-7 per trap haul) were also abundant and widely distributed. Berried females (up to 2 per trap haul) were less abundant, but present at each location. A low recapture rate (four recaptures from 462 lobsters tagged and released; 0.9%) suggests migration across and/or substantial daily movements within these coastal habitats at this time of year. As a consequence, greater numbers of lobsters may be exposed to dredge disposal activity than would be expected for a closed population, recently depleted by fishing. In a separate holding experiment, to evaluate exposure risk, lobsters in good physical condition were placed in traps (with closed escape vents and entrances) set at four sites near the 2004 disposal permit area boundaries. Traps remained in place for 2 d during which dredge disposal was underway. Upon retrieval, none of the lobsters were moribund or exhibited external indications of sub-lethal exposure to high sediment loads. Several design deficiencies limit conclusions which can be drawn from this preliminary experiment. Recommendations for follow-up studies are provided.

RÉSUMÉ

Lawton, P., MacIntyre, A.D., Robichaud, D.A., and Strong, M.B. 2005. Preliminary studies on coastal habitat occupancy by lobsters, *Homarus americanus*, in relation to dredge spoil disposal in the approaches to Saint John Harbour, New Brunswick, Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2718: iv + 23 p.

En juillet 2004, des cassiers à homard (avec panneaux d'échappement fermés) ont été pêcher à trois endroits dans les approches du havre de Saint Jean, N.-B., après la fin de la saison de pêche commerciale et avant le début des activités annuelles de dépôt de matériaux de dragage dans le site d'immersion en mer de Black Point. Durant quatre jours d'échantillonnage, 2 840 homards furent capturés avec 134 cassiers levés. Durant chaque jour d'échantillonnage, les homards sous légaux (<83 mm longueur de carapace) étaient les plus abondants, avec en moyenne de 11-22 homards par cassiers. Les homards légaux (2-7 par cassier) étaient aussi abondants, et très distribuer. Les femelles oeuvées (jusqu'à 2 par cassier) étaient moins abondantes mais présentes à chaque endroit. Un taux peu élevé de recaptures (4 recaptures à partir de 462 homards marqués et relâchés : 0.9%) suggère une migration à travers/ou des mouvements journaliers substantiels à l'intérieur de ces habitats côtiers pendant ce temps de l'année. Comme conséquence, un plus grand nombre de homards pourrait être exposé aux matériaux de dragage, qu'on pourrait s'attendre d'une population fermé et récemment réduit par la pêche. Dans une expérimentation séparée pour évaluer les risques d'exposition, des homards en bonne condition physique furent

placés dans des cassiers (avec panneaux d'entrée et d'échappement fermés) à quatre endroits près de la ligne de démarcation du permis de dépôt de 2004. Les cassiers ont restés en place pour deux jours pendant le dépôt de matériaux de dragage. Après la récupération, aucun des homards étaient moribonds ou exhibait aucune indication externe d'exposition mortel causé par de haute concentration de sédiment. Plusieurs défauts dans le projet, limite nos conclusions qui peuvent être tiré à partir de cette recherche préliminaire. Des recommandations pour poursuivre ces études sont présentées.

INTRODUCTION

The Black Point Ocean Disposal Site (Fig. 1) receives spoil material from annual enance dredging at the mouth of the Saint John River, New Brunswick. In operation since Black Point is the largest ocean disposal site in Atlantic Canada (Envirosphere Consultants 003), and although initially selected as a dispersive site, spoil has accumulated, resulting in rmation of a shoal (Fig. 2) which requires ongoing management. The responsible federal nment agency regulating this activity, Environment Canada (EC), has previously sponsored es of studies under its Disposal at Sea Monitoring Program to evaluate the effects of long- use of the Black Point Ocean Disposal Site. These studies have been primarily focused on minants, geochemistry, seabed biological community description, geophysical survey, field irements, and oceanographic modeling (A. MacDonald, Environment Canada, Dartmouth, Scotia, personal communication).

During winter 2003, Fundy North Fishermen's Association (FNFA, Box 241, Lepreau, Brunswick E5J 2T1) made representations to the Department of Fisheries and Oceans) and EC, requesting that additional scientific studies be undertaken in 2004. Specifically, requested an evaluation of the population size structure of lobsters occupying coastal ts in the approaches to Saint John Harbour over summer months, and an assessment of the tial effects of exposure to dredge spoil material on lobster condition.

To assist in these evaluations, local fishermen volunteered to set lobster traps in the aches to Saint John Harbour after the Lobster Fishing Area (LFA) 36 fishing season closed ne 30, 2004. Fishermen acting on behalf of FNFA were permitted by DFO (Appendix 1) to to 50 modified commercial lobster traps in the period from the closing date to July 31, for the purposes of determining the population size structure of lobsters (reported under er size structure and catch rate in commercial traps). This permit was subsequently ded to facilitate participation by local fishermen in conducting a trap-based holding iment to determine the effects of proximity to dredge disposal events on lobster condition rted under Short-term response of lobsters to dredge disposal events).

This report provides documentation on preliminary trap-based studies conducted in 2004, rovides recommendations for follow-up studies. Background information on the LFA 36 y, in terms of general stock status, landings history, number of fishery participants, etc. can und in Lawton et al. (2001a). A comprehensive summary report on prior environmental toring at the Black Point Ocean Disposal Site was provided to Environment Canada, tic Region, Dartmouth, Nova Scotia, by Envirosphere Consultants Ltd. (2003), to which the r is referred for additional context.

METHODS

STER SIZE STRUCTURE AND CATCH RATE IN COMMERCIAL TRAPS

Fishermen used their own commercial lobster gear, but closed the escape vents in order ain sublegal lobsters more effectively. The traps used were an American design (comprising itchen and two parlour areas) constructed of plastic-coated wire mesh. Traps were 120 cm

by 56 cm wide by 33 cm high with wire mesh squares of 3.8 cm x 3.8 cm, and a hoop size 7.8 cm. All traps were set as singles, baited with about 700 g of frozen herring. The raphical position was recorded for each trap set within three separate locations in the oaches to Saint John Harbour (Fig. 1). Traps were set over approximately 0.5-km^2 areas at k Point and Anthonys Cove, while at the third location, Mispec Point, fewer traps were set a much smaller area (approximately 0.05 km^2). Traps were typically set along lines (Fig. 1), a general spacing between individual traps of 80 m (approximate range 30–200 m).

Prior to the start of the survey a professional marine biologist (A.D. MacIntyre) nunicated DFO protocols to fishermen for quality assurance, including the use of field data ding sheets (Appendix 2). Information to be recorded by individual trap included the size pace length, CL, to the nearest mm), sex category (male, female, egg-bearing (berried) le), and moult condition (hard-shelled, soft-shelled) of each lobster retained.

Additionally, fishermen tagged a proportion of the lobster catch from each day's trapping ity by placing a rubber band over one of the claws (so as not to impair claw use), before sing the lobster to the water. In the event of recapture of a previously tagged lobster, an ional band was to be placed upon the claw (and recorded in the data sheet; Appendix 2) to ify both single and multiple recaptures of individual lobsters.

Completed field data sheets were forwarded to DFO's Science Branch, Biological on, St. Andrews, New Brunswick, where the catch information was entered into an Oracle onal database using a unique trip identifier. The Crustacean Research Information System S; database manager: M. Strong) provides a wide range of trip reporting options, including epresentation of catches in terms of estimated weight. Estimated weights are calculated in for individual lobsters in different sex categories using the following equations:

Male lobsters: $Wt\ (g) = 0.000608 * CL\ (mm)^{3.0583}$
Female lobsters: $Wt\ (g) = 0.001413 * CL\ (mm)^{2.87465}$
Berried lobsters: $Wt\ (g) = 0.004820 * CL\ (mm)^{2.6383}$

nding on client preferences and reporting requirements, query results may be outputted CRIS in either kg or lb per trap haul.

RT-TERM RESPONSE OF LOBSTERS TO DREDGE DISPOSAL EVENTS

Lobsters to be used in the holding experiment were obtained on July 20, 2004, from traps h had been set 6 d previously in an area near Mispec Point (Fig. 1). Lobsters selected for use e experiment were in hard-shell condition, had both claws intact, and exhibited no obvious nal shell injury. Selected lobsters were divided into two size groups (70-80 mm CL; 81-110 CL) and both claws were banded to prevent lobsters from injuring one another.

Lobsters were placed in single-parlour lobster traps that had been sealed by closing both ntrance to the parlor, and the escape vents. Eight lobsters were placed in each trap (four the 70- to 80-mm CL group; four from the 81- to 110-mm group). The traps were then tied irs and a total of four traps were set at each of four target locations, selected relative to the

ndaries for 2004 dredge spoil disposal at Black Point (bounding box; Fig. 3). The tions consisted of a boundary site, situated mid-way along the southerly border of the box, then two sites 250 m and 500 m away from the boundary location, along the s of the accumulated dredge spoil heap, and a slump area, as determined from earlier ntal monitoring studies (Envirosphere Consultants Ltd. 2003; Fig. 2). A control site shed approximately 1 km away from the bounding box, at a similar water depth to the Following deployment on July 20, 2004, the traps were left in place for a 2-d soak ing which time dredge spoil disposal was underway within the bounding box.

or to trap retrieval on July 22, 2004, a 150-m transect line was deployed from the site, along the axis of the array of traps (approximately 170° magnetic). The bottom long the transect line was then videotaped by a SCUBA diver (with a hand-held Hi-8 t video camera) using a downward forward-looking angle of view encompassing a of approx 1 m. Periodic stops were made along the transect where the video camera panned horizontally to record general bottom topography.

each experimental trap was hauled, it was inspected to determine if there were traces spoil material associated with the trap structure. Each lobster was carefully removed ted for evidence of sediment accumulation in the vicinity of the gill cavity (under the rgin of the cephalothorax). Lobsters were also checked for their ability to freely move nae, claws, walking legs, and abdomen when these were manually stimulated. vere in place to retain for further detailed examination any lobsters which were found ound. Eight lobsters from each of the four trap locations were selected and returned to drews Biological Station for storage, in anticipation that there may be interest in chemical assays at a subsequent date.

RESULTS

R SIZE STRUCTURE AND CATCH RATE IN COMMERCIAL TRAPS

ee separate locations were fished during July 2004 (see Fig. 1 for trap positions; Table ber of trap hauls). The number of soak days at each trapping location varied between 2 d. Fishing activities were restricted to daylight hours and high tide periods, due to essel access at Mispec wharf (several hours either side of high tide). A total of 2840 ere captured and measured for biological variables during the four trapping days, with obsters measured each sampling day (Table 1; Fig. 4-7). The mean size of male nged from 74–79 mm CL between trapping days; female mean size ranged from 73–77 hile the mean size of berried females was considerably larger (103–111 mm CL), as lue to the size of sexual maturity being considerably larger than the minimum legal mm CL) for the commercial fishery in the Bay of Fundy. Due to the small number of in the survey, size frequencies from the three sampling areas are combined and as aggregate plots for each of the four hauling days (Fig. 4-7).

the first three trapping days fishermen tagged a total of 462 lobsters, ranging in size 46 mm CL (Table 2). Approximately 27% of the lobsters tagged were below minimum

e. Only four lobsters (0.9%) were recaptured (each lobster once only) during the second hauling days.

s the escape vents of the traps were closed, catch rates of sub-legal lobsters were very raging from 11-22 sublegals per trap haul on a daily basis in the three locations (Table n a maximum of 39 sublegals in one trap haul (Fig. 8A). Sublegal lobsters were also istributed across the trapping areas (Fig. 8A). Particularly at the smallest size retained in (51 mm CL), these lobsters would not be expected to have moved long distances to traps. Catch rates of legal lobsters were also high, considering the numbers of sublegal lso in the traps, averaging 2-7 legals per trap haul, with a maximum of 12 legals in one (Fig. 8B; see also Table 1B). In terms of catch weight, the maximum observation for ed lobsters was 22 lb in one trap haul, as derived from estimated weights of lobsters . Although there was some variability in catch rates in the three locations, and between gal lobsters were also widely-distributed in the approaches to Saint John Harbour. emales were observed in lower numbers per trap haul (up to 2 per trap haul), and were ved in all trap hauls (Fig. 8C). Nonetheless, berried lobsters were present in each of the ations (Table 1).

TERM RESPONSE OF LOBSTERS TO DREDGE DISPOSAL EVENTS

wo traps were videotaped on bottom at the boundary location prior to being hauled on 2004. There was no apparent increase in sediment in or around each trap as it was set on n, and lobsters were observed to be moving around inside the traps.

he 150-m video transect was conducted in water depths ranging from 21–25 m (as ed from the SCUBA diver's depth gauge). Three lobsters (one occupying a burrow) erved within approximately 1 m either side of the transect line (300-m^2 bottom area), representing a density of one lobster per 100 m^2, considered a moderately low density ientary environments in the lower Bay of Fundy (P. Lawton, pers. observ.). The diver rted some observations of excavated lobster burrows in the soft but consolidated mud, were not investigated due to the restricted bottom time available. Although fine was predominant, there were patches along the transect where shell hash accumulations ountered, indicating the presence of epifaunal and infaunal invertebrates and perhaps d feeding by lobsters (no species identifications, or examinations of broken shell were made). The bottom topography was irregular, with some discrete mounds, or elongate features rising up to 50 cm above the principal bottom surface. Visibility was ately 1.5 m, with significant turbidity noted in the near-bottom water column.

he holding experiment achieved good accuracy in the deployment of the paired traps ect to the four target locations, with recorded trap deployments occurring between 5 and m the targets (Fig. 3). Lobsters retrieved from the traps showed no obvious signs of to an increased sediment load. One lobster had shed one claw, which may have been (but not with obvious marks) when initially placed in the trap. Other than this on, all lobsters retrieved from the traps appeared to be in good condition, with no of lethargy.

DISCUSSION

ZE STRUCTURE AND CATCH RATE IN COMMERCIAL TRAPS

pping survey from July 9–14, 2004, demonstrates that a significant population of e present in the vicinity of the Black Point Ocean Disposal Site after the close of mercial fishery. Continued immigration and local movement of lobsters in the Saint John Harbour in the early summer may lead to a greater number of lobsters lly affected by dredge spoil disposal than would be expected for a closed ently depleted by commercial fishing.

ining the degree of lobster movement with the existing survey coverage is ow recapture rates, such as those observed on the second to fourth hauling days in le suggestive of high rates of movement, have also been observed in other closed surveys in areas where high rates of movement were not expected. For example, mblay (2003) tagged 200 lobsters in Little River, Nova Scotia, and on three s of fishing retrieved only four lobsters (2%). In another summer trapping survey, Island, Lobster Bay, Nova Scotia, 256 lobsters were tagged on 1 d of fishing, and recaptured on the following day (J. Tremblay, Bedford Institute of Oceanography, , pers. commun.).

gh in neither of these survey locations in Nova Scotia was high movement is a considerable amount of historical information, and results from recent studies ement in other parts of the Bay of Fundy which support the interpretation of the in the present study as indicative of high movement activity. In a trapping survey uly 1992 in the vicinity of St. Martins, New Brunswick, a total of 3010 lobsters d released on 10 fishing days over an 18-d survey period (Robichaud and Lawton hing vessels conducted the trapping survey and recaptured 47 lobsters during the 1.5%), of which 11 lobsters had moved >5 km. The trapping area was adjacent to ith LFA 35, in which the commercial season was still open in July. A total of 205 were recaptured by LFA 35 fishermen during July, and based on the shortest stance between release and recapture points, these lobsters were recaptured at an e of 19 km (ranging from 10–51 km) from the release location within a 3- to 29-d aud and Lawton 1997). The averaged rate of movement towards LFA 35 was 1.4

et al. (2001b) summarise results of a trapping survey conducted by the Grand hens Association in September and early October, 2000, off Grand Manan Island, The number of traps fished by individual fishermen (who operated in different cations) was similar to the current survey. A portion of the catch from 1669 trap 4-wk survey period was tagged prior to release using similar protocols to those esent study. From 5243 lobsters released, recapture rates varied from 1.2-5.9% dual fishermen (n = 4). In follow-up surveys on Grand Manan in 2001 and 2002, capture rates were obtained, along with instances of long-distance recaptures obichaud, unpubl. data).

Diver observations in this study, and prior remote video surveys (Parrott and Strong 2003) indicate that some lobsters will excavate burrows (typically associated with their sheltering requirements) in these predominantly depositional environments. Thus, a portion of the adult lobster population immigrating from deeper water in the spring may take up residency, perhaps for a considerable portion of the summer months, and may also utilize burrows for moulting activity. The development, composition and persistence of shallow-water seasonal lobster assemblages has not been extensively studied (historical studies reviewed by Lawton and Lavalli 1995).

The presence of substantial numbers of sublegal lobsters (the smallest lobster retained in the traps was 51 mm CL) in each of the three locations indicates the potential that these coastal habitats provide some nursery area function. In fact, it may be possible that the long-term disposal of dredge spoil at Black Point, by creating a relatively extensive shallow-water structure in a previously deeper-water area, may have improved the habitat conditions for juvenile lobsters. Although it is considered that initial lobster settlement is much lower in sedimentary environments than complex hard-bottom areas, there is also an indication that settlement is higher in shallow-water habitats than in deeper areas (Wilson 1999). Long-term disposal activity has created a shallow bank with minimum water depths of approximately 5 m below mean low water (Fig. 2). As reviewed by Envirosphere Consultants Ltd. (2003), this buildup is thought to be due, in large part, to the disposal of gravel, rock and boulders originating from areas of seabed not previously dredged, as well as silt/clay from current dredging. Over the years, periodic slumping has occurred, creating a slump area which extends several kilometres south and southeast of the disposal site (Fig. 2). In 2000, analysis of bathymetric and geophysical data suggested a main spoil pile area of 0.8 km^2 and a slump area of 2.0 km^2 (Envirosphere Consultants Ltd. 2003). Again, little is known on the occupation of depositional environments by juvenile lobsters, such as whether or not these are year-round occupants. It is considered that long-distance and significant seasonal shallow-deep water migration in lobsters is primarily conducted by legal-sized lobster (reviewed by Lawton and Lavalli 1995).

The July 2004 trapping survey did intercept berried female lobsters, but the catch rates were lower than those which have been seen in some similar recent closed season trap surveys on Grand Manan and in Chignecto Bay (Lawton and Robichaud, unpubl. data). However, these other surveys were conducted later in the summer months, and the decision to close the escape vents in the current survey, by increasing the capture of sub-legal lobsters, may have reduced the capture rate of berried female lobsters.

SHORT-TERM RESPONSE OF LOBSTERS TO DREDGE DISPOSAL EVENTS

It was not possible for trap placement in the holding experiment to be specifically coordinated with concurrent dredge spoil disposal. Thus, the orientation and distances at which the traps were placed were determined relative to the permit boundaries of the dumping box (Fig. 3), rather than from specific dumping locations within the box.

Review of dredge spoil disposal records indicated a total of 25 disposal events reported in the period July 19–22, 2004, during each of which approximately 601 m^3 of dredge spoil was

deposited, for a total of 14,424 m^3 (S. Lewis, Environment Canada, Dartmouth, Nova Scotia, pers. commun.). These disposal events occurred from 1 d prior to the setting of holding traps, through the 2-d soak period, to trap retrieval on July 22, 2004. The centroid location for these disposal events (45.210883° latitude/66.020784° longitude; NAD 83) was derived within geographic information system software (Mapinfo), and distances calculated from that point to the actual holding locations. Distances from this centroid were: Boundary site, 189 m; 250-m site, 405 m; 500-m site, 629 m; Control site, 1019 m. The lack of any sediment accumulation on the traps at the boundary station when they were observed *in situ* suggests that the original experimental design led to the trap holding locations being established too far away from the disposal events. There were no concurrent quantitative measurements taken of suspended sediment loads during the 2004 experiment (for example, using sediment traps at each holding location) to evaluate this possibility, and addition of suspended sediment monitoring in subsequent biological effects monitoring would be beneficial.

A subsequent holding experiment was proposed to be undertaken during August–October 2004, for which a more coordinated approach was recommended, with notification in advance of specific dumping locations and dates, and arrangements made for traps to be placed more specifically in relation to these planned activities. Due to various circumstances this second holding experiment was not conducted.

Later in 2004, additional geophysical information (provided by R. Parrott, Geological Survey of Canada (Atlantic), Dartmouth, Nova Scotia, from unpubl. data) indicated a more westerly direction for the plume of material from recent disposal activities at the Black Point Ocean Disposal Site than was originally assumed, pointing to a general design deficiency in the 2004 trap experiment.

CONCLUSIONS AND RECOMMENDATIONS

Field surveys were conducted on an *ad hoc* basis during 2004 due to the timing of the permitting process and uncertainties over feasible survey approaches and funding. Nonetheless, the trap-based surveys conducted by LFA 36 fishermen shortly after the close of the spring lobster fishery indicate that fishermen are very capable of conducting scientific observations, with appropriate coordination by professional marine biologists. The biological information collected was of very consistent quality, and indicated that there was a significant population of lobsters occupying coastal habitats in the approaches to Saint John Harbour in July, comprising juveniles, berried females, and legal-sized lobsters which had escaped the recent fishery.

It was not possible to conduct additional trapping activity over the remaining months of the summer closed season. From previous trapping surveys conducted in other areas of the Bay of Fundy throughout this period (e.g. Robichaud and Campbell 1991), it is expected that there would be further seasonal changes in size composition and biological condition (such as moult and reproductive status) which would influence both individual and population level vulnerability. Prior work conducted jointly by DFO and the Geological Survey of Canada (Atlantic) using the URCHIN remote video survey system (Parrott and Strong 2003; Strong and Lawton 2004) provides some information on habitat occupancy at the Black Point Ocean

Disposal Site during the month of September. The URCHIN system could potentially be used in follow-up surveys to augment trap-based approaches.

Although the dredging and disposal activity occurs annually during the summer closed season, additional sampling within the regular commercial season may assist in better understanding the role that these coastal habitats play in sustaining local lobster populations. Fishermen have noted the presence of quite small sublegal lobsters in their commercial trap catches from this area (David Thompson, FNFA, personal communication), which suggests these are year-round residents. The use of juvenile-directed trapping approaches (using traps with a smaller mesh size than commercial traps) in the regular fishing season, and as part of an expanded closed season survey, could corroborate these anecdotal observations.

In order to fully evaluate the current function of the Black Point Ocean Disposal Site as lobster habitat, and level of risk from dredge spoil disposal, there is a need for a better experimental design, and survey coordination with annual disposal activity, than was possible to achieve during 2004. Trapping could be undertaken systematically over a greater area prior to disposal activities, with the provision for follow-up surveys, both during disposal operations (such as by having a cessation of dumping for 2-3 d), and after the dumping program is completed.

Concurrent measurements of suspended sediments at stations across the trapping area could assist with interpretation of trapping results. Obviously, adjustments to the dredging and disposal schedule to accommodate specific lobster monitoring requirements must be coordinated in advance, and managed closely. As the principal disposal site at Black Point is used intensively (many disposal events per day; many consecutive days of operation), there may be more opportunity to develop an experimental regime at an alternative disposal site off Anthony's Cove (Fig. 1).

During 2004, some limited diving-based observations were obtained which indicate that it may be possible, at least in the shallower portions of the Black Point Ocean Disposal Site, to undertake direct *in-situ* observation of the nature of the bottom sediments and the density of lobster occupancy. The URCHIN remote video system, as discussed by Parrott and Strong (2003), could be used in a coordinated manner with additional diving and trap-based sampling approaches. Fishermen with experience of the local area through the commercial fishery, and those involved in the 2004 trapping survey, were surprised at the population densities which were determined from these initial diving and video observations.

How trap catches relate to the actual population size structure and densities of lobsters on the bottom is a complex issue, as the entry of lobsters into traps depends on size, sex, moult status, intra- and interspecific interactions, and physical factors such as water temperature, currents and bottom habitat (Miller 1990; Tremblay and Smith 2001). Nonetheless, traps are often the most practical approach for fishery-independent surveys where the bottom is either too deep, turbid, or otherwise not cost-effective to sample by diving (Tremblay and Smith 2001; Smith and Tremblay 2003). Trapping is best considered as an indicator of relative abundance, but if trapping surveys are well designed, changes in catch rates and size structure can be used to infer changes in lobster population characteristics. In analyzing a stratified random sampling

design (based on depth and alongshore location) used in a fishery-independent trap survey off northern Cape Breton, Smith and Tremblay (2003) concluded that the survey design used could possibly detect catch rate differences of 20%, which they found encouraging for the development of an annual index of catch rate. However, they cautioned that their finding of significant differences in catch rates in surveys conducted 1 wk apart (likely due to weather factors) underscored the complexities inherent in using trap-based indicators of abundance.

Thus, to evaluate changes in lobster catch rates due to disposal activity, there will be a requirement to establish a control location where some of the additional factors which affect lobster catch rates (such as weather, and lower catch rates during moulting periods) could be monitored. Survey designs, including grid-based trapping surveys (recently used in impact assessment of ocean disposal programs; Wahle et al. 2003), will need to be carefully considered for their efficiency in deriving quantitative estimates of changes in lobster distribution and relative density.

ACKNOWLEDGEMENTS

Jeff Cline and Connie Farr (DFO) helped with the scientific licence approval process and interactions with FNFA; Ted Currie (DFO) provided insights into DFO regulatory responsibilities; John Calvin (Hughes Surveys) participated in the design and execution of the holding experiment. Steve Doyle (Irving Oil) and Stephen McCavour (Saint John Port Authority) provided information on their respective dredging and disposal activities. Scott Lewis and Adrian MacDonald (EC) helped with integrating the lobster survey with prior environmental monitoring at Black Point. Russ Parrott, Geological Survey of Canada (Atlantic), generously provided access to unpublished geophysical survey information. Finally, we acknowledge the coordination provided by Dave Thompson on behalf of FNFA and the professional conduct of the voluntary trapping survey and holding experiment by Dave and fellow LFA 36 fishermen Roger Hunter, Fred Thompson, Neil Smith, Clifford Moore and Wayne Hunter.

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Table 1. Lobster catch composition during closed season trap survey. (A) Number of trap hauls each day (TH), soak days, and overall catch by sex category for three locations. (B) Average catch rate by location and date for legal-sized (male and female lobsters ≥ 83 mm CL, excluding berried female lobsters), and sub-legal lobsters (male and female lobsters < 83 mm CL), expressed as number (N) per trap haul and weight (lb) per trap haul. Total catch per trap by number and weight includes berried female lobsters.

(A)

Location	Date	TH	Soak days	Number of lobsters by sex category			
				Male	Female	Berried	Total
Black Point	09/07/2004	29	1	288	282	12	582
	10/07/2004	30	0.5	185	216	9	410
	12/07/2004	30	2	391	366	12	769
	14/07/2004	10	2	101	114	3	218
Anthonys Cove	14/07/2004	20	2	280	275	10	565
Mispec Point	10/07/2004	5	0.5	36	34	2	72
	12/07/2004	5	2	43	65	0	108
	14/07/2004	5	2	62	51	3	116
Total		134		1386	1403	51	2840

(B)

Location	Date	Legal catch		Sublegal catch		Total catch	
		N/TH	lbs/TH	N/TH	lbs/TH	N/TH	lbs/TH
Black Point	09/07/2004	3	5	17	10	20	16
	10/07/2004	2	3	11	7	14	11
	12/07/2004	5	9	20	13	26	23
	14/07/2004	6	10	16	10	22	21
Anthonys Cove	14/07/2004	6	10	22	15	28	26
Mispec Point	10/07/2004	3	5	11	8	14	13
	12/07/2004	6	10	15	11	22	21
	14/07/2004	7	13	15	11	23	26

Table 2. Information on lobsters tagged and recaptured during July 2004 trapping survey.

Date	Size tagged (CL, mm)	Category tagged (N)			
	Min. - Max.	Sublegal	Legal	Berried	Total
9/07/2004	63 - 128	53	72	11	136
10/07/2004	71 - 142	31	68	11	110
12/07/2004	79 - 146	42	162	12	216
Total N tagged		126	302	34	462
Percent tagged		27.3%	65.4%	7.3%	100%
Total N recaptured		1	2	1	4
Percent recaptured		0.8%	0.7%	2.9%	0.9%

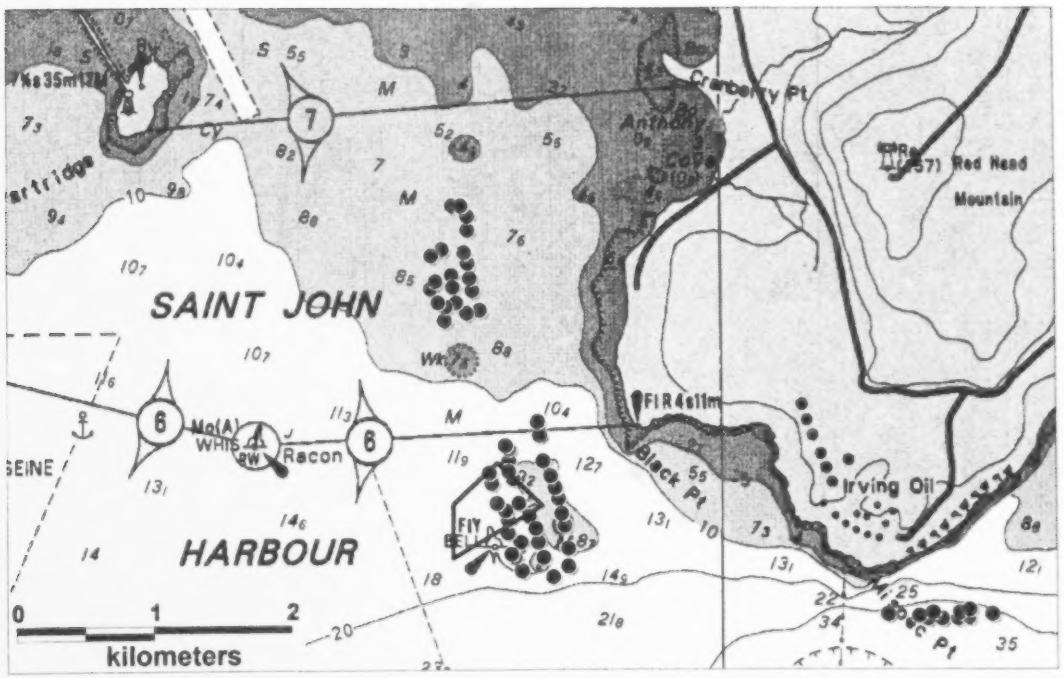
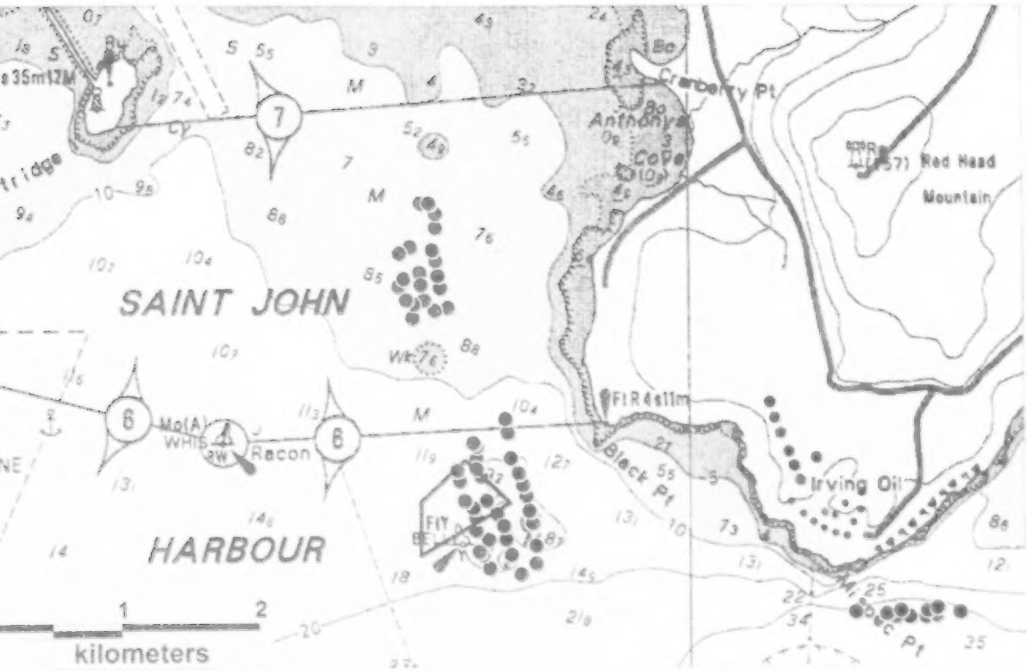


Fig. 1. Geographical features in the approaches to Saint John Harbour, permit boundaries for 2004 dredge spoil disposal at the Black Point Ocean Disposal Site (black polygon), and recorded lobster trap positions (black circles) from the July 9–14 trapping survey.



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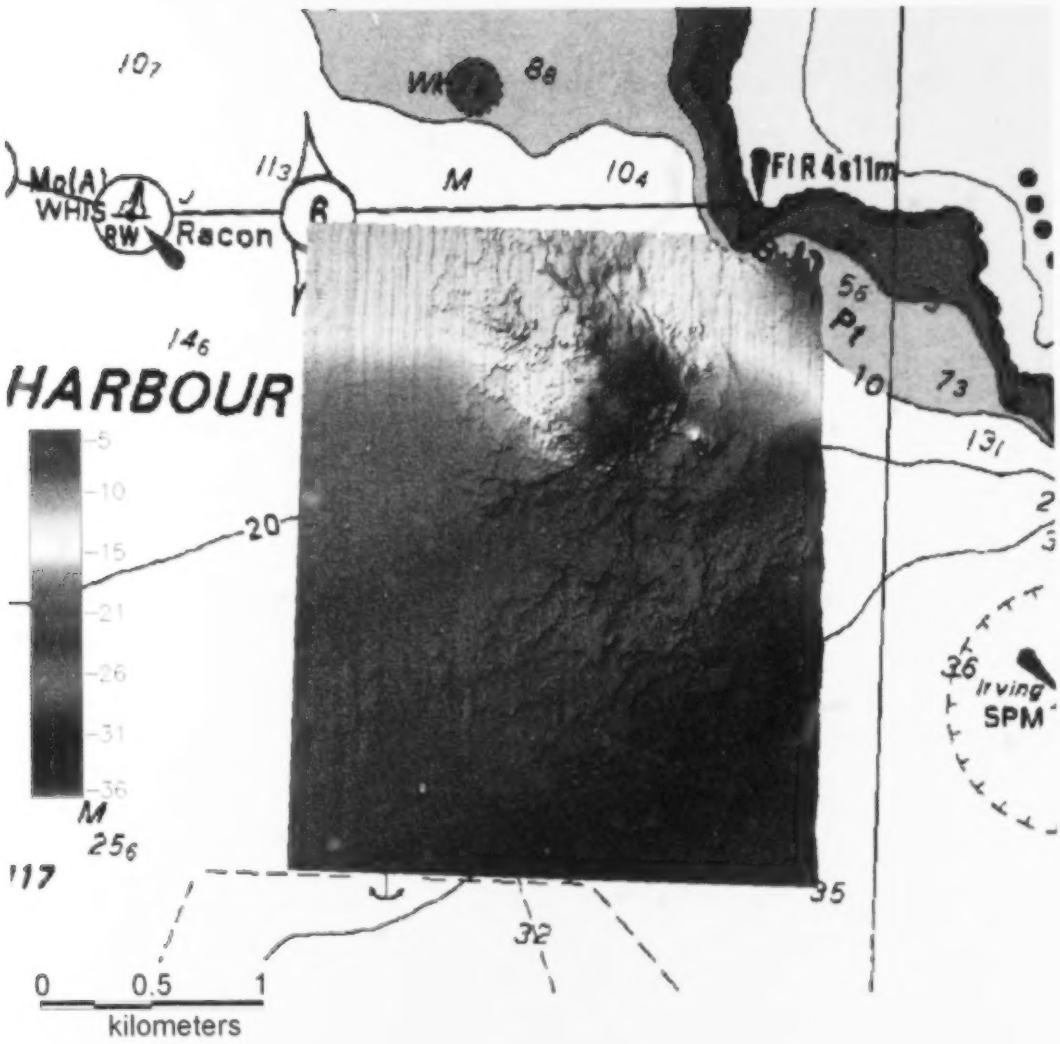
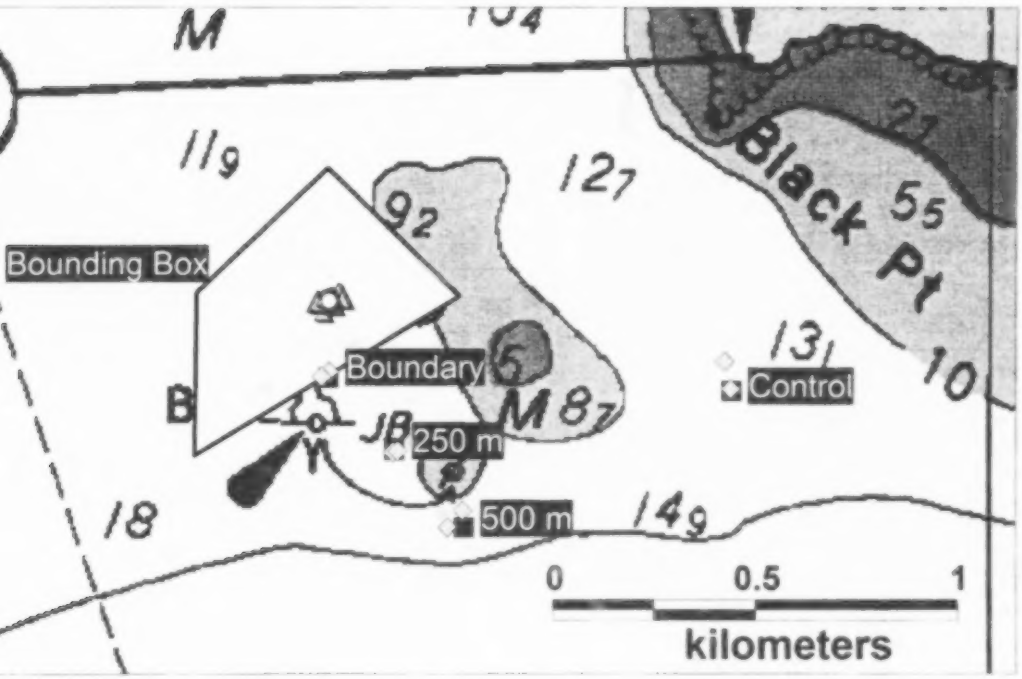
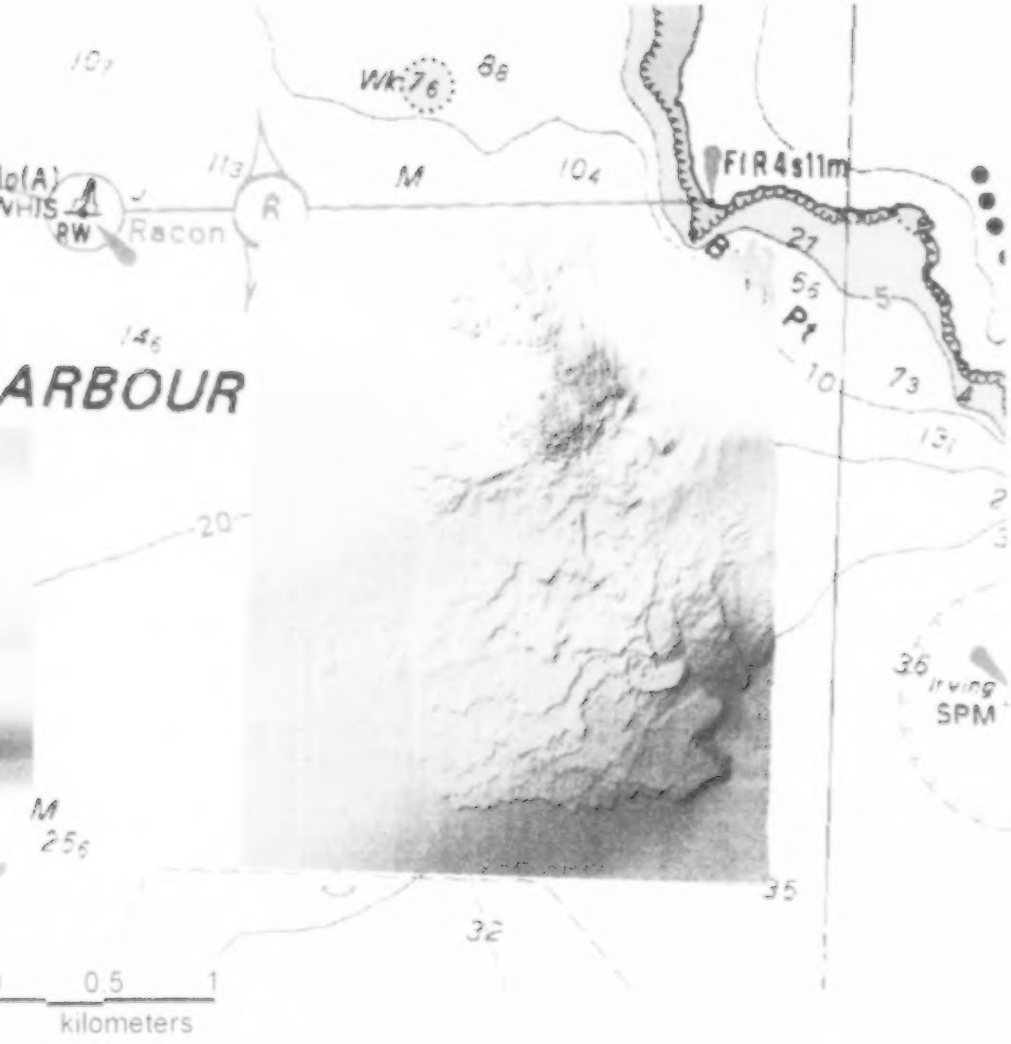


Fig. 2. Current bathymetry of the Black Point Ocean Disposal Site, as determined from a multibeam sonar survey conducted in July 2004 (Russ Parrott, Geological Survey of Canada (Atlantic), unpublished data). Water depth is colour-coded from 5-36 m below mean low water across an approximate 6.7-km^2 survey area.



3. Black Point Ocean Disposal Site 2004 bounding box, holding trap sites, and fic dredge spoil disposal events between July 19 and 22. Target locations shown as squares, overlaid by actual holding trap set positions on July 20 (grey diamonds). ions of specific dredge disposal events between July 19 and 22 are shown as grey gles. The centroid for these dredge disposal events is indicated as a white circle.



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ridge spoil disposal events between July 19 and 22. Target locations shown as
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of specific dredge disposal events between July 19 and 22 are shown as grey
The centroid for these dredge disposal events is indicated as a white circle

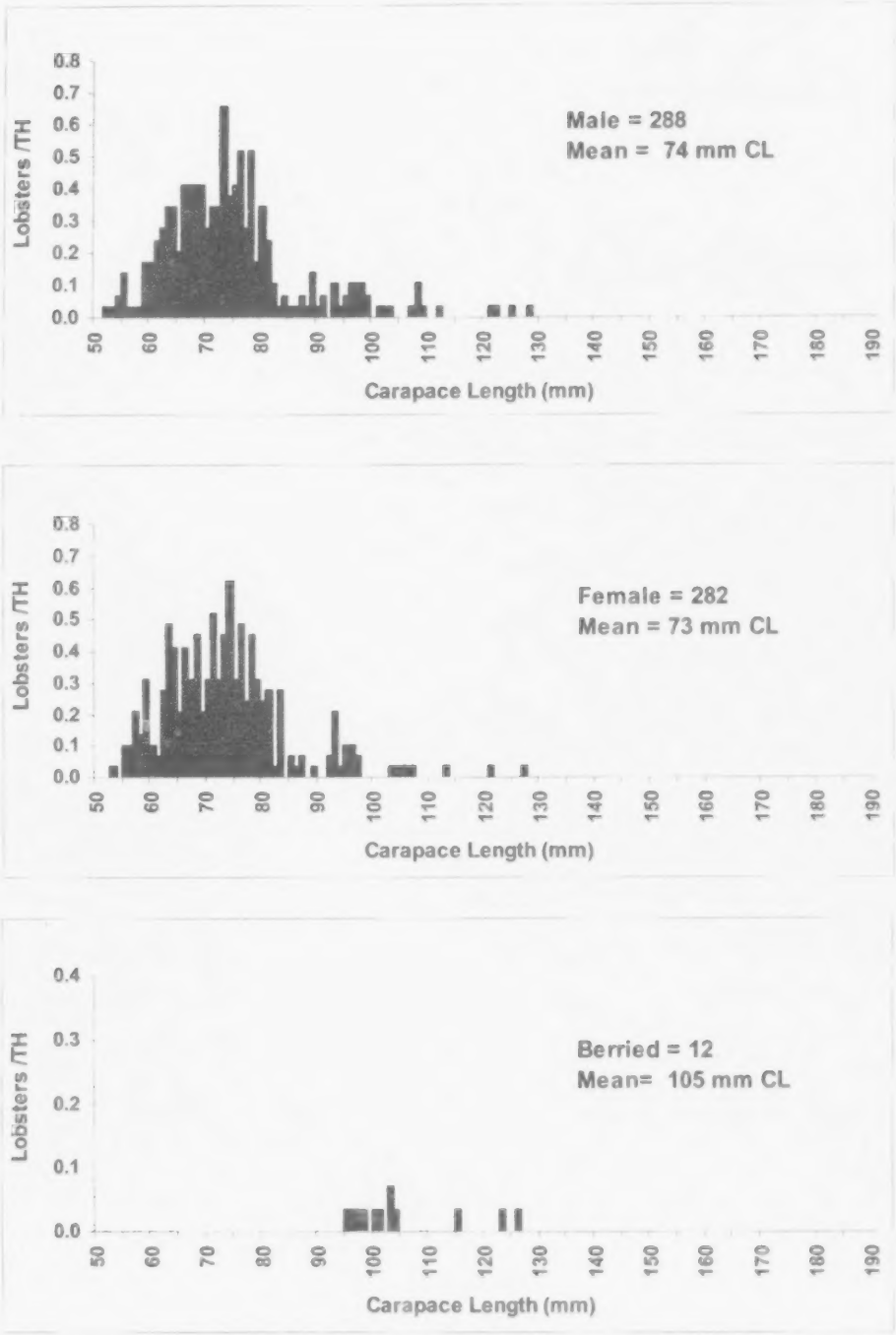


Fig. 4. Frequency distribution of the number of lobsters per trap haul (TH) by 1-mm CL size category for male, female, and berried female lobsters from closed season trap survey in the approaches to Saint John Harbour, July 9, 2004 (Trip 6546) [based on 29 trap hauls].

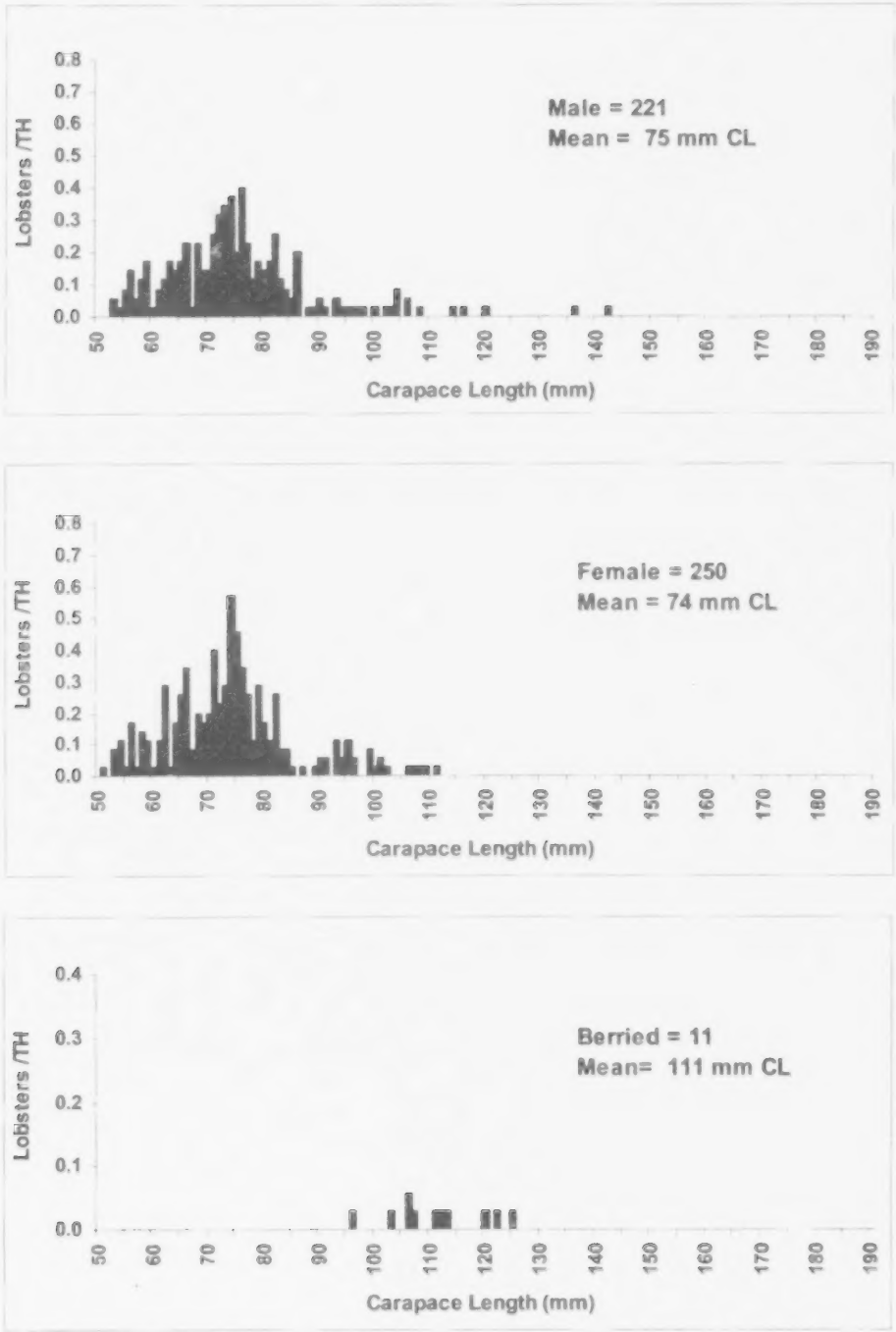
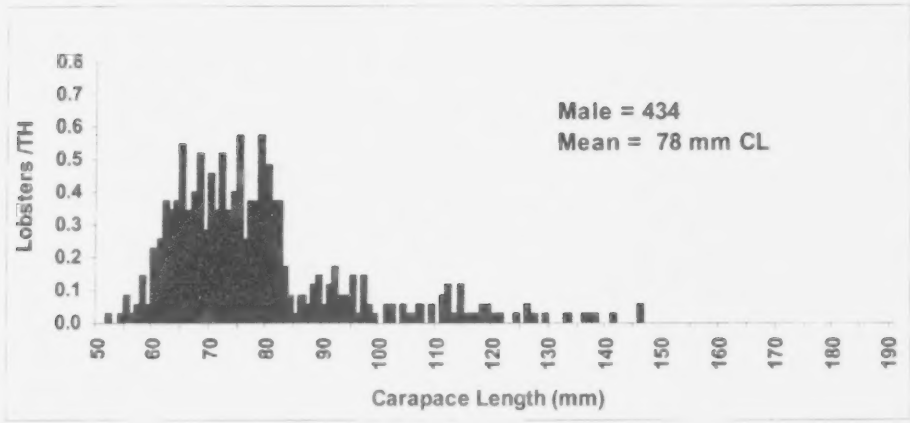
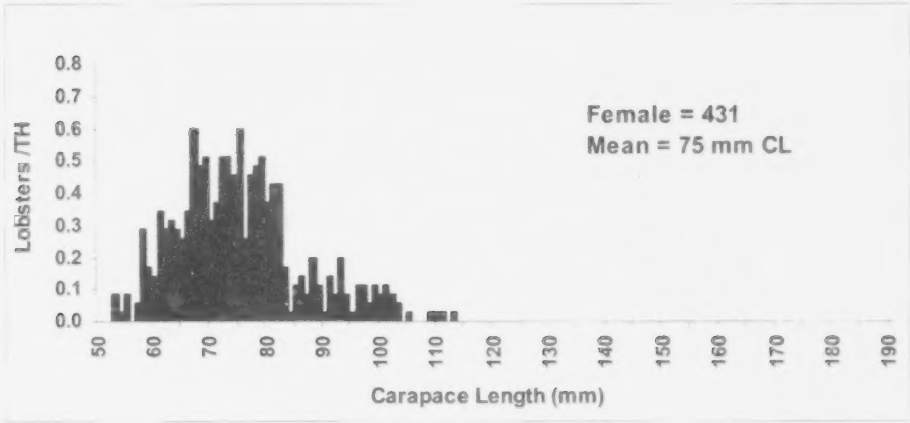


Fig. 5. Frequency distribution of the number of lobsters per trap haul (TH) by 1-mm CL size category for male, female, and berried female lobsters from closed season trap survey in the approaches to Saint John Harbour, July 10, 2004 (Trip 6568) [based on 35 trap hauls].





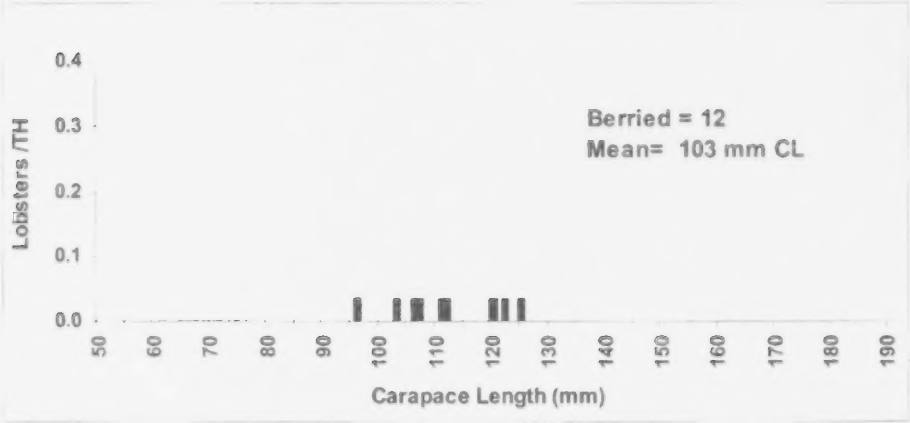
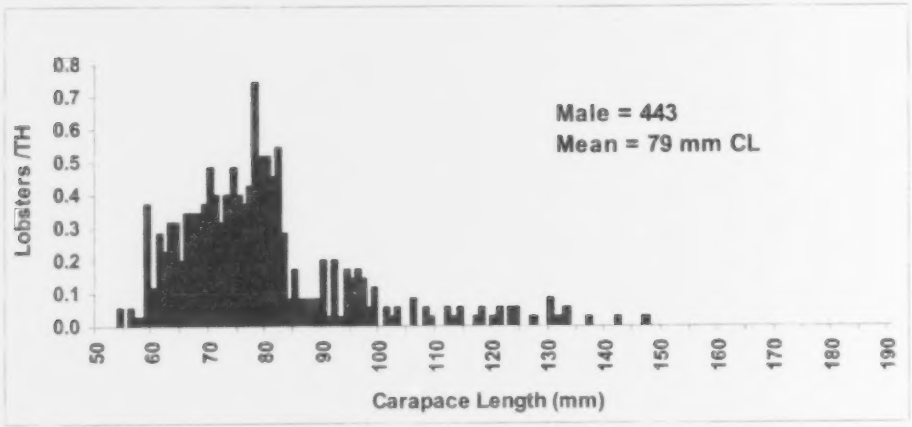
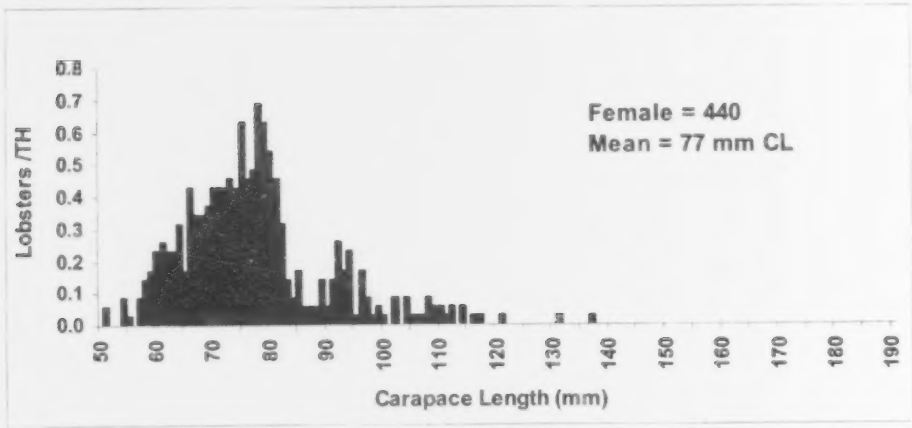


Fig. 6. Frequency distribution of the number of lobsters per trap haul (TH) by 1-mm CL size category for male, female, and berried female lobsters from closed season trap survey in the approaches to Saint John Harbour, July 12, 2004 (Trip 6569) [based on 35 trap hauls].





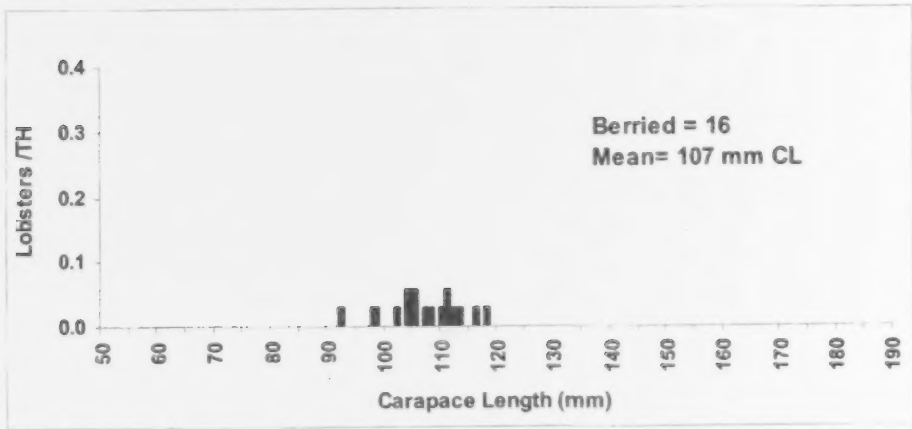
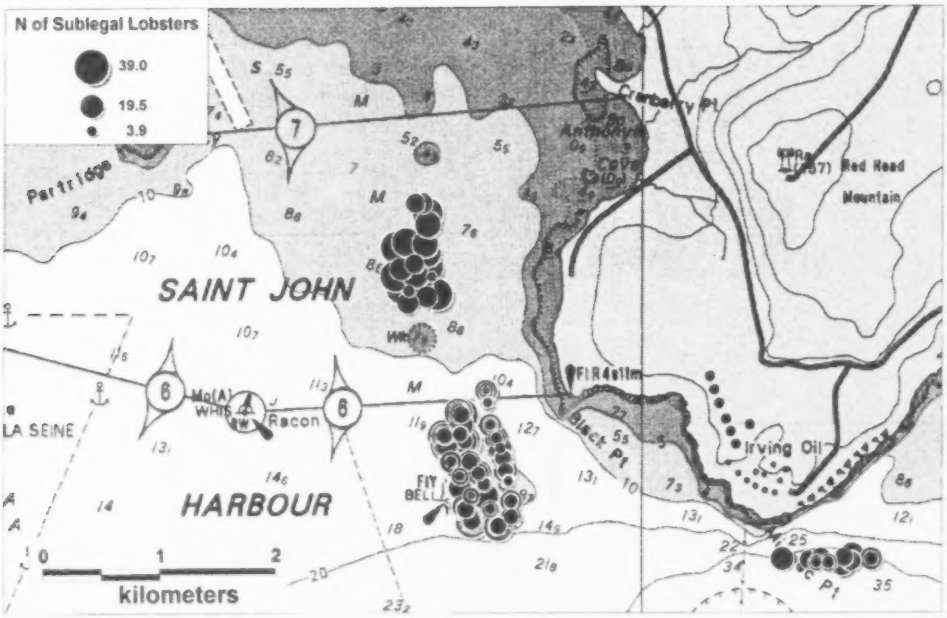


Fig. 7. Frequency distribution of the number of lobsters per trap haul (TH) by 1-mm CL size category for male, female, and berried female lobsters from closed season trap survey in the approaches to Saint John Harbour, July 14, 2004 (Trip 6573) [based on 35 trap hauls].

(A)



(B)

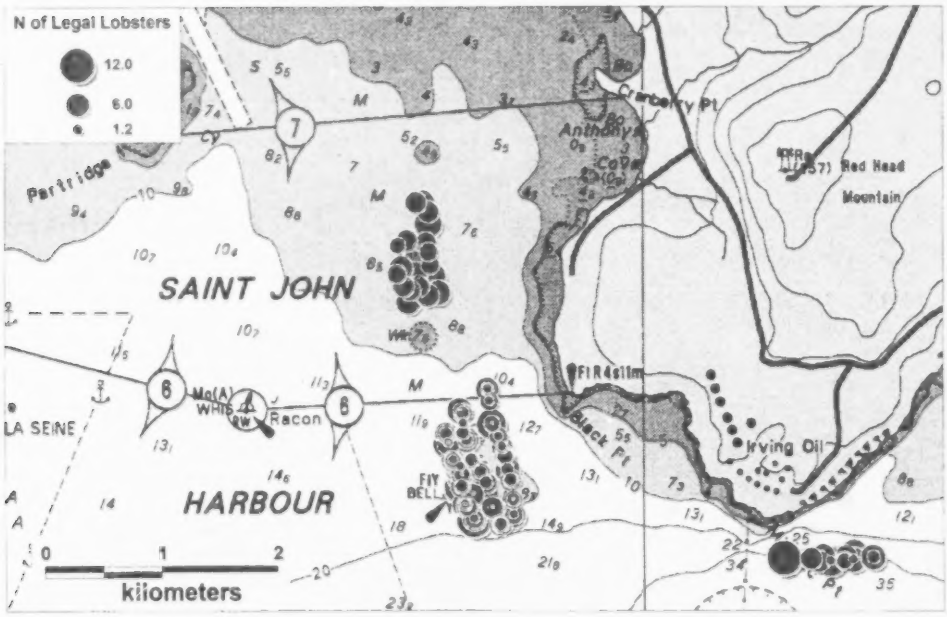
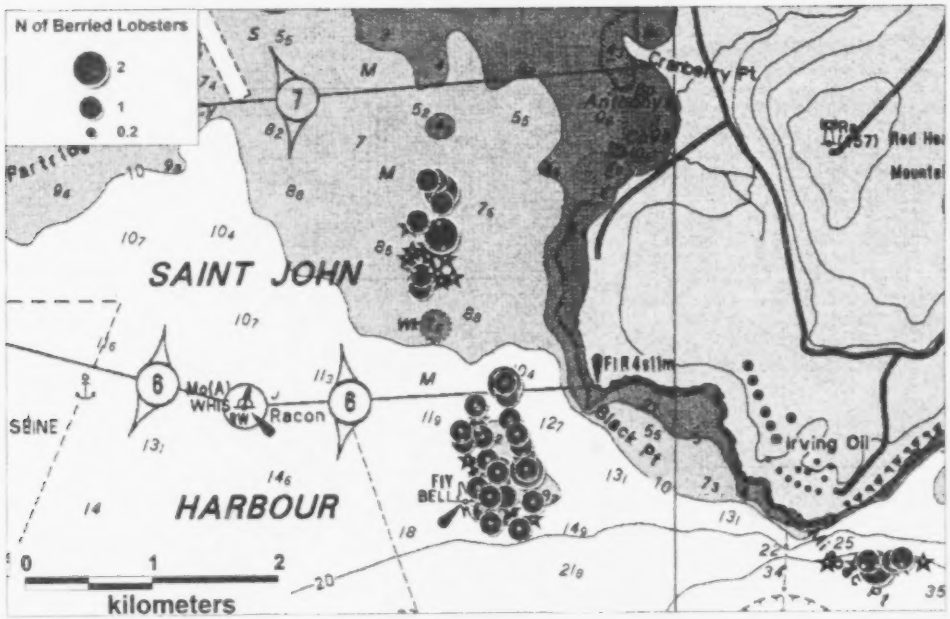


Fig. 8. Lobster catches reported by individual trap position over the 4-d trapping survey for (A) sublegal lobsters, (B) legal lobsters. Note that the scales differ between the individual maps. Trap locations where there were no lobsters of the specified category are indicated by black stars.

(C)



(D)

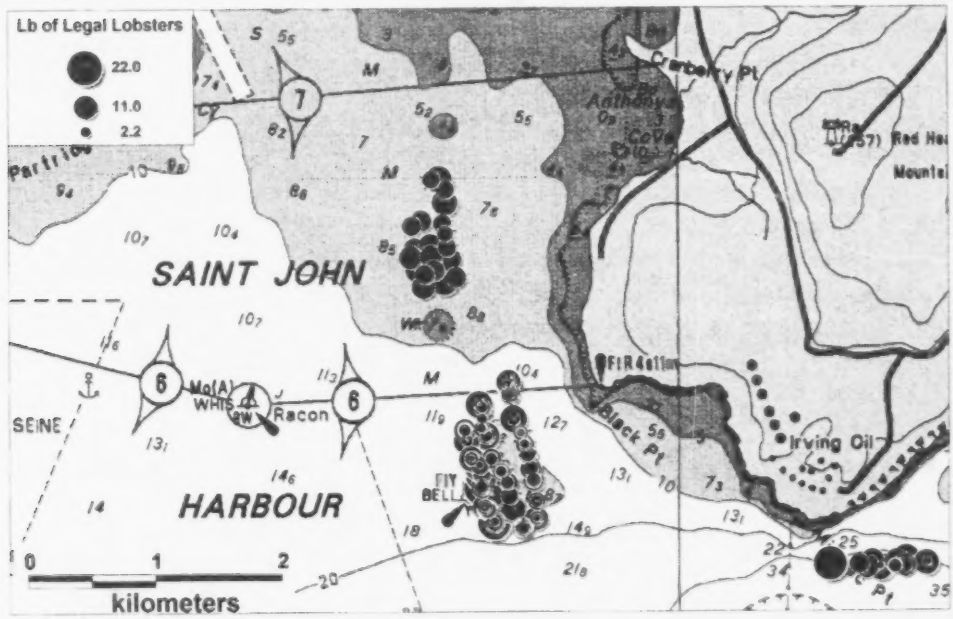
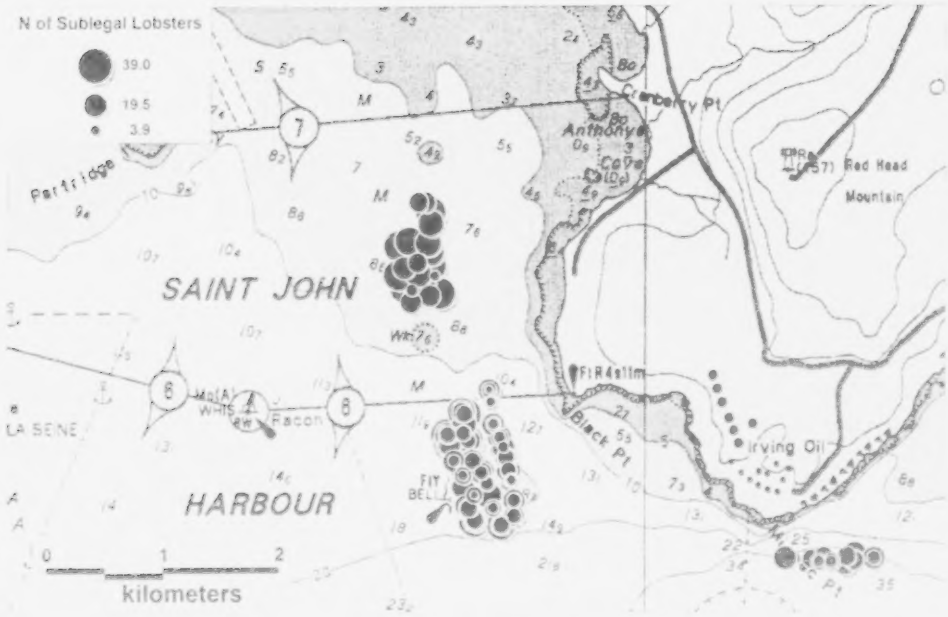


Fig. 8 (cont.). Lobster catches reported by individual trap position for (C) berried female lobsters and (D) catch rate of legal lobsters expressed as weight (lb) per individual trap haul. Note that the scales differ between the individual maps. Trap locations where there were no lobsters of the specified category are indicated by black stars.

(A)



(B)

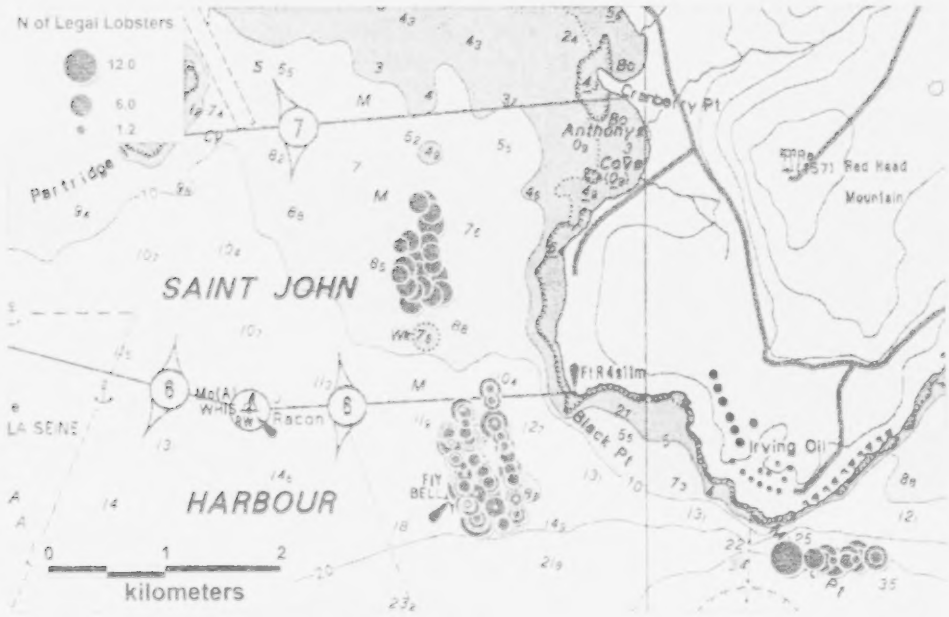
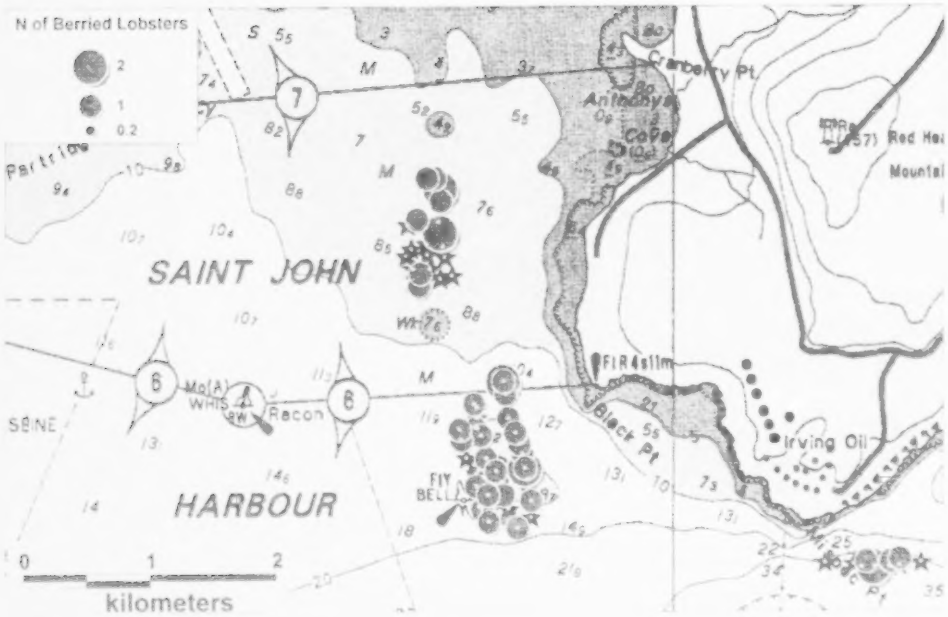


Fig. 8. Lobster catches reported by individual trap position over the 4-d trapping survey for (A) sublegal lobsters, (B) legal lobsters. Note that the scales differ between the individual maps. Trap locations where there were no lobsters of the specified category are indicated by black stars.

(C)



(D)

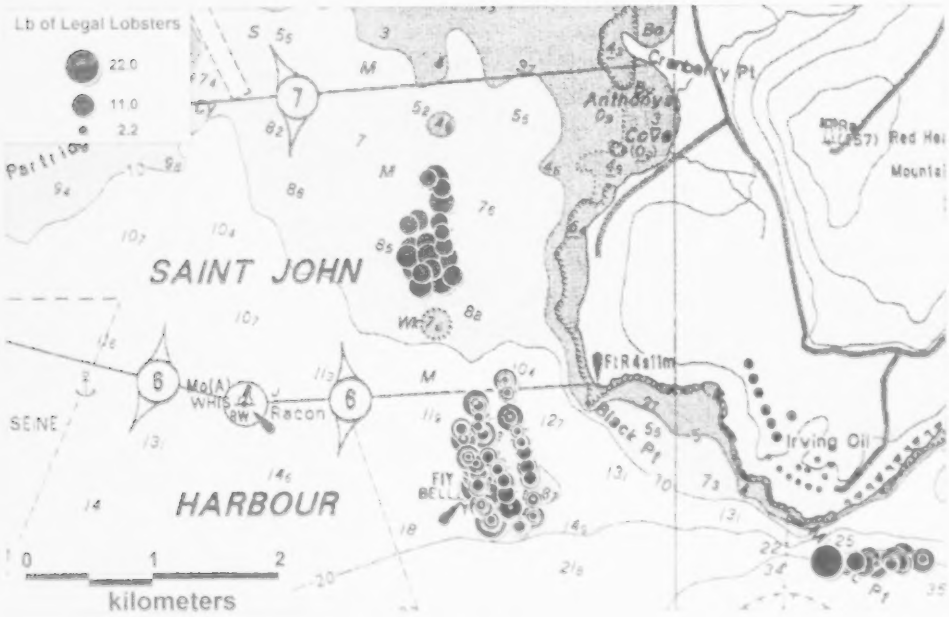


Fig. 8 (cont.). Lobster catches reported by individual trap position for (C) berried female lobsters and (D) catch rate of legal lobsters expressed as weight (lb) per individual trap haul. Note that the scales differ between the individual maps. Trap locations where there were no lobsters of the specified category are indicated by black stars.

ix 1. Scientific licence (partial copy) issued to Fundy North Fishermen's Association for eason trapping work in 2004.

Fisheries and Oceans Canada | Pêches et Océans Canada

TIFIC LICENCE

3

t to section 52 of the ***Fishery (General) Regulations,*** as amended, this Licence is issued y North Fishermen's Association, Box 241, Lepreau, N.B. E5J 2T1, commercially lobster fishers to conduct sampling of legal and sub-legal lobsters in conjunction with Andrews Biological Station, Science Branch, Maritimes Region, under guidance of **Dr. awton**, Lobster Biologist, telephone (506) 529-8854, fax (506) 529-3862, for the purpose lishing a benchmark in abundance of lobsters and mapping their distribution in the Bay y area, at the Black Point disposal site Saint John Harbour (map attached) subject to the g conditions:

That the names of lobster fishers, vessel names and Vessel Registration Numbers (VRN) re identified in the **Appendix I**, attached to and forming part of this Licence;
That each vessel must be operated by the lobster licence holder identified in **Appendix I**;
That the sampling is restricted to the Lobster Fishing Area #36, where the fisher has a valid commercial lobster licence;
That the sampling method be by means of unmodified and modified inshore and offshore obster traps with closed escape vents as provided by Fisheries and Oceans Canada DFO), Science Branch;
That no fish caught under this Licence be retained for human consumption;
That all lobsters caught in these modified traps be returned, unharmed, to the waters from which they were taken immediately after the collection of any necessary data;
That the maximum number of modified traps is **fifty** (50) per fisher and each fisher is permitted to set and haul this gear ten times during the survey period;
That all gear used for sampling will be identified by a valid tag issued by DFO as per **Appendix I**, attached to and forming part of this Licence;
That all fishers listed in **Appendix I** carry a copy of this Licence while conducting their operations and will be made available for inspection upon request by a Fishery Officer;
That the undernoted will be contacted prior to the commencement of the project and provided with the details of times, locations and names of participating fishers: Area Director, SWNB - telephone (506) 529-5850, fax (506) 529-5858;
That this Licence is valid between the date of issue until July 31, 2004; or until dredging operations start at the site;
That issuance of this Licence implies no commitment by the Minister or the Department o reissue the License in subsequent years.

Field data form used for recording trap type, and the condition of each lobster
e, sex, moult status, v-notch status), along with tagging information, trap location,
oak time for each trap sampled.

Black PointLobster Survey

Port_____ Captain_____ Vessel_____ Sampler_____ Date (DD/MM/YY) ___/___/___

Area of trapping Activity_____ Trip No. _____ Page _____

Trap No.	Trap Type	Vent Closed	Size (mm)	Sex	Shell Hardness	V-Notch	Tagged	Size (mm)	Sex	Shell Hardness	V-Notch	Tagged	Size (mm)	Sex	Shell Hardness	V-Notch	Tagged	Size (mm)	Sex	Shell Hardness	V-Notch	Tagged	Depth (fm)	Soak Days	LOCATION Latitude Deg.	Min	.oo	Longitude Deg.	Min	.oo	Comments: